

# Beta Decay and Quark-Antiquark Non-Parity in Collision-Induced Gravity

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The quark-antiquark interaction, with non-conservation of parity, associated with neutrino-nucleon inelastic scattering, and electron/positron decay consequent to nuclear transmutation and re-materialization, are invoked as the phenomena responsible for heat carry-off. The mechanism is applied to collision-induced gravity, including quantitative justification, using Feynman parton theory. The application to heat dissipation necessarily involves the tri-quark current that associates with weak interactions.

## 1 Introduction

Parity refers to the operation of studying a system or a sequence of events reflected in a mirror plane [1]. In chemistry and biology, the term “chirality” is used, instead of parity, and refers to a structure that is different from its mirror reflection, and from this property, very important criteria of handedness and broken symmetry arise [2]. In physics, a deeper understanding of the meaning of parity (often called space parity) refers to every real object or process having a mirror image that *obeys the same physical laws* as the original object. It was originally assumed that parity is conserved upon collisions, and this implied that elementary particles have antiparticles, such as neutrinos and antineutrinos, such that the antiparticle subscribed to the *same* physical laws as the particle. This all changed with the publishing of Lee and Yang’s seminal work [3] that argued that parity was *not* conserved in weak interactions. One such interaction is radioactive decay, described to arise from what is referred to as the “weak force”, contrasting the strong force and electromagnetism both of which are shown to conserve parity in interaction with matter. Experiments by Wu et al. [4] involving the direction of beta decay emitted from  $\text{Co}^{60}$  in a magnetic field (thus relative to the associated applied magnetic field vector) confirmed that in beta decay, parity is *not* conserved. The relationship between *gravitating* bodies is also a manifestation of weak interactions. In both a field-based wave-mechanical model of gravity, and a particle-based collision-induced model of gravity [5, 6], parity is thus interpreted to be non-conserved.

The theoretical analysis [6], which was based on the interpretations from super K data that the neutrino oscillations between flavors could only occur if the neutrino had a rest mass, was cast in terms of a net transfer of *linear* momentum, but since it is now known that the neutrino always possesses left-handed helicity, and since it is reported that upon inelastic collision between a neutrino at  $v \sim c$ , and a proton or a neutron, the flavor of the neutrino has a very high probability to change — thus the spin magnetic moment property of the particle changes — the analysis is broadened herein to include *total* angular momentum. The nucleon’s spin properties, the

neutrino’s spin properties, and the neutrino’s essentially linear velocity at collision, all then demand the consideration of spin angular momentum *and* linear angular momentum; however, since quark properties must also be considered in an inelastic interaction with protons or neutrons, the orbital angular momentum must also be treated in a full analysis.

A major element of a collision-induced gravity model that has not been yet explained is how the heat generated in the inelastic collision is carried-off from the local neighborhood of the 3D coordinates of the collision. Without fully explaining heat carry-off, such a model is not complete. The major purpose of this current work is to propose to an international forum of readers, a model for the phenomenological basis of this removal of heat, so as to receive feedback and stimulate further work.

In the interest of simplicity in basic modeling, the collision-induced mathematical analysis did *not* treat the effect of a change-in-flavor of the neutrino (flux) consequent to a neutrino-nucleon inelastic collision due, for example, to a collision with nucleons of the moon during a total solar eclipse, which would then generate a change in the collision cross-section that could affect a subsequent collision with another mass body (such as an interaction with a gravity measuring experimental apparatus located at an Earth laboratory). As a more comprehensive knowledge of the properties of the neutrino is emerging, it seems *unlikely* that a collision of a neutrino with a mass particle would *not* cause a change in flavor. Although the original model [6] has been successful [7] in generating the total solar eclipse (occurring March 1997 in China) gravitational anomaly dip signal detected by Wang et al. [8], and elaborated upon by Yang and Wang [9], adjustment parameters are employed to reproduce the signal, especially in the central region of the signal, but the fundamental *functional* basis for these collision-related parameter adjustments is not yet established.

In wave mechanics terms, and in a particle approach, when the spatial coordinates are reflected from coordinates  $x, y, z$  through the origin to position  $-x, -y, -z$ , non-conservation of parity means that what is physically expected/observed at  $x, y, z$  is *not* the same as what is expected/

observed at  $-x$ ,  $-y$ ,  $-z$ . In the model/theory of collision-induced gravity this has profound importance, and herein is applied to explain the process of heat carry-off after the inelastic scattering net-transfer-of momentum interaction that the collision model invokes as the fundamental cause of gravity. Without solving the heat-carry-off problem, the collision model suffers vulnerability to a potentially critical weakness.

In our original theoretical work [6] we utilized  $10^{-38}$  cm<sup>2</sup> for the collision cross-section of the neutrino with the neutron, as well as for the collision cross-section with the proton — a value now supported by other studies [10] that relate to the Feynman parton model, and about one order of magnitude higher than the values of sigma arising from earlier work [11]. This is an extremely small collision cross-section, and implies a very enormous flux density of particles such that the neutrino could be considered a realistic candidate for the particle that carries the gravity interaction property. The paradox is that even though experiments such as those conducted in the Super K project or related works, report that it is exceedingly difficult to detect a neutrino (as with scintillator counter devices), these calculations and the interpretations of experiments, do not consider that the neutrino is taking part in gravity interactions, and thus is implicitly detected. If the neutrino is indeed responsible for collision-induced gravity, then the equipment and experiment that is being utilized to detect its collisions with nucleons — such as the 50000 gallons of nuclide treated water, and the associated scintillation counters — is itself detecting neutrinos by virtue of the gravitational interactions related to the experiment as a whole.

## 2 Initial hypothesis

My own interpretation of very important and unique experimental work of the collimated free-falling neutron experiments at Grenoble [12] is that gravitational interactions must be quantized. And my own hypothesis as to the origin of that quantization, and also the origin of the phenomenon that explains the carry-off of heat generated from an inelastic scattering interaction (in which although momentum *is* conserved, energy is *not* — because of the involved heat), is cast in terms of the quantum mechanics of neutrino-nucleon inelastic collision, and this necessarily must involve the quark constituents of the nucleon. (If this were not so, then I see no way in which gravity can be quantized, and no way that collision-induced gravity could pass all of the scrutinizing tests necessary for embracing a model/theory as viable in modern physics.) Thus the hypothesis must include that the quark-antiquark interaction is involved in the heat carry-off phenomenon.

## 3 Related original experimental results

For the details regarding experimental findings, including the non-constancy of  $G$ , that are not explicable through field the-

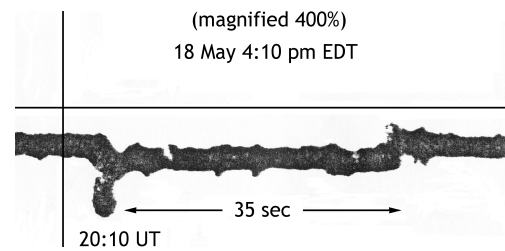


Fig. 1: Original raw data [16] of anomalous dip in gravity detected by use of laser scattering between two gravitating dual-cable suspended pendula, during the planetary line-up/syzygy of 18 May 2001: Earth/Sun/Jupiter's-magnetosphere/Saturn. The leading edge of the signal when expanded is a parabolic dip very similar to the initial parabolic dip detected by Wang et al. [8] for the 1997 total solar eclipse in China. The trailing edge is a parabolic bump, not analogous to any reported data known to the author. I interpret the above signal as due to occulting by the chromosphere-photosphere 1000 km zone of the Sun associated with an enormous change in temperature (from 10,000 to 1,000,000 degrees) and a major change in density, characteristic of the corona region.

ory, including General Relativity, see [8, 9, 13–16]. The original data for my own experimental work, measuring a gravitational anomalous dip ( $\sim 35$  sec) on 18 May 2001 (16:10 hrs EDT) during the lineup of Earth-Sun-Jupiter's magnetosphere, and Saturn is given in Fig. 1 [16]. This signal was measured using two close-proximity dual-cable suspended Newton cradle pendula. The inter-pendula distance was interrogated with a 100 mw He-Ne cw laser. A change in the very short length-scale inter-pendula distance caused a change in the scattered laser radiation which was detected by a light-detecting diode. The output of the diode detector was fed into a Goerz 7800 chart recorder in the  $Y$  vs  $t$  mode, and also into a computer using an analogue-to-digital converter. All apparatus was mounted on an optical bench floating on inner tubes, and within a screened enclosure to preclude stray signals. Isolation transformers and RC filters were employed to minimize effects of transients. The operational amplifiers were employed on an offset scale for highest sensitivity so that the magnitude of the dip in gravity, which is shown in Fig. 1, is a relative measurement in arbitrary units. To my best estimate, the decrease in gravity due to the syzygy is of the order of a few microgals (see caption to Fig. 1). At the time of the measurement of the anomalous dip shown in Fig. 1, by use of a telescope attached to the experimental apparatus, I could clearly see the two pendula separating slightly due to the weakened gravity because of the presence of the Sun, Jupiter's magnetosphere, and Saturn that had moved between the deep space source of neutrinos and the Earth-laboratory.

The work of Refs. [8, 9, 13–16] strongly argue that  $G$  is *not* a constant, and this has been readily shown by the work of Gershteyn et al. at the Massachusetts Institute of Technology, reporting [17] that  $G$  varies at least 0.054% as a function of the orientation of the vector between the two gravitating

Cavendish spheres and the direction to large stars, and also that  $G$  is periodic with the sidereal year. This histogram periodicity can only develop, in my judgment, if gravity is based on external impinging particles such that once per sidereal year the bulk of the Earth is interrupting the flux of gravity-bearing particles some of which never reach the measuring instrumentation (the Cavendish spheres). More precise examination of data of highly controlled robotically measured experiments such as that of Ref. [17] should be capable of measuring indications of periodicity of  $G$  on a monthly and daily basis as well. My own work determined the value of  $G$  (measured in 2007 in New England) as  $G = 6.692 \pm 0.10 \times 10^{-11}$  cubic meters per kg sec<sup>2</sup> [18]. This work was accomplished with a fixed 16 pound spherical composite non-conducting resting mass located on a micro-moveable track, and a close-proximity 3 gram cork pendulum suspended from a nylon fiber. The inter-mass distance was interrogated by a HeNe cw laser, the radiation of which was scattered by the gravitating masses, and detected by a light-detecting diode and/or a solar cell, the output of which was fed into an oscilloscope.

The spatial and temporal patterns of the scattered laser light were measured as the massive sphere was slowly moved, by a servo-mechanism, toward the oscillating cork pendulum, which caused the frequency of oscillation of the cork pendulum to change slightly. By measuring this change in frequency ( $\Delta f$ ) as a function of distance between the gravitating masses, we could determine the change in interacting energy, and determine the change in the associated force between the gravitating masses. We tested for any charge concentrations on the gravitating masses, and observed none. The theoretical analysis for the massive-sphere/pendulum interaction can employ either a Newtonian approach or a Lagrangian approach, yielding the same results. From these analyses we could extract the value of  $G$ . Our work also showed that our value of  $G$  changed somewhat if a film of water replaced air as the inter-mass medium, and changed again, if the temperature of that water was altered from 22°C to about 60°C.

Both our work and the highly accurate laser-cooling interferometric Pb micro-mass work of Fixler et al. at Stanford (published earlier in 2007), giving  $G = 6.693 \times 10^{-11}$  [19], is at significant variance from the accepted averaged value of 6.67, and thus indicates that corrections must be made to those determinations based on using the standard accepted value of  $G$ . As a function of collision parameters [6],  $G$  is expected to change with time, and with location of the position of measurement in the galaxy, and in the universe.

Our earlier measurements showed that  $G$  changes as a function of temperature according to  $G = G_0(1 + aT)$ , where  $a$  is a micro-valued constant in accord with measurements taken much earlier in England, and also changed as a function of phase (increasing as ice melts to water) and as a function of shape (increasing as a loop of 1 mil diameter Cu wire underwent multi-convolutions of the loop to approximate a sphere such as a spool of wool) [16,18].

#### 4 Theoretical discussion

The parton model, advanced by Richard Feynman, postulates that the nucleon is composed of point-like constituents, referred to as partons. The partons share the total momentum of the nucleon by constituting variable fractions of the total momentum, designated (within the Feynman model) by the variable  $x$ . The probability,  $f(x)$ , of the parton to carry momentum does *not* depend upon the process in which it is engaged, or the nucleon energy, but is an intrinsic property. This, in my own interpretation, is fundamental to collision-induced gravity — namely that the carrying and transferring of momentum is an intrinsic property of the neutrino-nucleon interaction, and this is why, at least in part, the gravitation interaction is weak. The partons are composed of the three quarks (referred to as the valence quarks), but also includes the quark-antiquark pairs emerging from vacuum point energy, explicable by the uncertainty principle as well as involving gluons which are quanta of the strong force of quark interactions. The question naturally arises of how a *weak force* non-parity-conserving interaction can affect *strong force* quanta. Because the momenta of quarks (and of gluons) are added to give proton momentum, and from implication of the collision-induced gravity theory, I wish to postulate herein that there exists a constraint, and although strong forces/interactions are necessary to break quark-quark bonds and break apart the nucleus, weak forces are sufficient to change, for example, a d-quark (down-quark) to u-quark (up quark) which involve a transmutation of a neutron to a proton, and which gives rise to a quark-antiquark interaction, otherwise quantum mechanical selection rules could not emerge. Justification for this postulate is given subsequently.

It is thus proposed herein, based on my own interpretation of what is necessitated and implied in collision-induced gravity model and theory, that

...the within-nucleon transition of a d-quark to a u-quark, or the reverse, is associated with the formation of an antiquark, without the requirement of GeV energies necessary to break apart the nucleus.

(Because of the broken parity, I believe that further analysis and research must be conducted to determine/understand any thermal properties that might be associated with the antiquark).

The laws of quantum mechanics as applied to the wave function that is associated with the quark-antiquark system, imply that for a quark and antiquark, having angular momentum,  $L$ , the parity is established by:

$$P = (-1)^{(L + 1)},$$

where  $L$  is an integer. Thus, in an even function, parity is conserved, but if the applicable function is an odd function, then parity is *not* conserved.

The amount of orbital angular momentum,  $L$ , and the spin angular momentum,  $S$ , of the quark-antiquark system is constrained by quantum mechanics as integers. Parity ( $P$ ) depends only upon relative orbital angular momentum between objects, however, charge conjugation ( $C$ ) depends upon both the orbital angular momentum and the combined spin states of the quark and antiquark. If the sum of  $L + S$  is an odd integer, then the wave function changes sign when charge conjugation is effectuated upon a collision between a neutrino and a nucleon. From the analysis, there are a set of allowed states  $J(PC)$  for a quark and an antiquark in net spin 0 and 1 coupled to orbital angular momentum,  $L$ , and total spin  $J = L + S$ . It is within the context of allowed  $J(PC)$  states whereby gravity is, I believe, quantized.

Since the neutron is believed to be spherically symmetric, having a much simpler topology than the proton (which appears to be peanut or torus shaped depending upon respectively whether the quark spin aligns with the proton spin or opposite to it), and since the magnetic moment of the neutron is opposite in direction to that of the highest magnetic moment neutrino flavor — the tau neutrino which has a magnetic moment two orders of magnitude higher than the electron neutrino and/or the muon neutrino — the neutrino-neutron inelastic interaction is first analyzed herein. (I believe that the change of shape of the proton, associated with the alignment relationship of the spin of the quark emphasizes the importance of the quark-antiquark interaction, as related to gravitation.)

The inelastic scattering interaction between the neutrino and the neutron can be described as:

$$\nu(0) + n(0) \longrightarrow p^+ + e^- + \nu_{[\text{anti}]}(0),$$

where  $\nu$  refers to the neutrino,  $p$  refers to the proton,  $e$  refers to the electron, 0 means charge neutrality, and  $+$  and  $-$  refer to positive and negative charge, and “anti” refers to an anti-particle. The above represents a nuclear transmutation creating an element of atomic number  $Z + 1$ , from an element of atomic number,  $Z$ , however the transiently created element having  $N - 1$  neutrons, yet essentially unchanged atomic weight  $A$ . This process must be associated with the creation of heat, and kinetic energy cannot be conserved. This neutrino-interaction generating a  $Z + 1$  atom must decay to the stable  $Z$  atomic number atom, and the created heat cannot be allowed to build up, thus must be transported from the system. The reverse-direction reaction, namely

$$p^+ + e^- + \nu_{[\text{anti}]}(0) \longrightarrow n(0) + \nu(0)$$

must also be valid in the description of collision-induced gravity\*. This then indicates that if the neutrino or the antineutrino perturbs the proton, then the electron can become

\*Otherwise, if the inelastic collision with the neutrino, only involved neutrons, then hydrogen (consisting of one proton, one electron, and zero neutrons) would not be observed to possess weight.

unstable and collapse into the proton, and combine with the proton to form a neutron (by changing the direction of one quark).

The reaction that then represents the decay of the unstable  $Z + 1$  state is normally written:

$${}^A_Z X_N \longrightarrow {}^A_{Z-1} Y_{N+1} + e^+ + \nu,$$

where  $X$  and  $Y$  designate different elemental atoms that differ by one proton, or by a single quark in the up-flavor ( $X$ ), rather than the down-flavor ( $Y$ ).

The equivalent reaction for the decay of the unstable state after the interaction between the neutrino and the proton is written as:

$${}^A_Z X_N \longrightarrow {}^A_{Z+1} Y_{N-1} + e^- + \nu,$$

where  $\nu$  represents the antineutrino. The above represents beta decay.

In summary of the above, it is postulated that the generated heat is carried off by the neutrino, and the antineutrino, ejected with changed energy, that are produced, respectively, in the above nuclear decay reactions, and do so according to quantum mechanical selection rules that emerge from the quark-antiquark non-conservation of parity interaction.

It is herein proposed that the Feynman work indicating that the cross-section for the neutrino-nucleon interaction can be described through the quark distribution functions,  $d\sigma/dxdy$ , which expressed in terms of momentum of the u-quark and the d-quark, is fundamental to explain collision-induced gravity. The work clearly shows that more momentum is transferred by quarks than by antiquarks.

The calculation yields that

$$\sigma_\nu = 1.56 \left( Q \pm \frac{Q}{3} \right) \times 10^{-38} \text{ cm}^2/\text{GeV},$$

where  $Q$  represents the momentum integral (for the integrated cross-section). This gives  $\sigma_\nu = 0.74 \pm 0.2 \times 10^{-38} \text{ cm}^2/\text{GeV}$  for the neutrino, and for the antineutrino,  $\sigma_{\nu_{[\text{anti}]}} = 0.28 \pm 0.01 \times 10^{-38} \text{ cm}^2/\text{GeV}$ . Therefore  $\sigma$  is linearly energy dependent for both the neutrino and the anti-neutrino, and, thus, so is the heat carry-off phenomenon. This also suggests that more heat is carried off by neutrinos than antineutrinos, and this must be because of the structural differences between the proton and the neutron, and differences in their collision cross-sections with respect to neutrinos.

The implication of a collision-induced gravity is that since gravity is statistical, and that the net change of momentum involves a flux of externally impinging particles, and certainly more than a single proton or neutron, and thus a collective effect of protons and neutrons interacting with external particles (neutrinos), such interactions will always be at least slightly different regarding the number of total particles involved. This implies that no two measurements, taking place



at two different time, of any experimental parameter will ever yield exactly the same value — this possibly related to some of the physical roots of the Uncertainty principle. Both the entity being measured, and the entity doing the measuring, are constantly changing to at least some infinitesimal level because of the stochastic properties of a particle-based gravity. This implies, for example, that typical Poisson statistics are not simply an instrument to assess statistical error in measurements, and standard deviation, but are a fundamentally related to the statistical properties of gravity.

Before this paper can attain closure, it is necessary to furnish scholarly support for my postulate that the quark-antiquark interaction (necessary for establishing the quantum mechanical selection rules that give rise to heat carry-off) can arise from weak interactions. As a career condensed matter basic research physicist, who for the past ten years has been working in gravitation measurements, and interpretations thereof aimed at an understanding of the fundamental cause of gravity — not being a theoretical particle physicist — I had to recruit the assistance from others upon realizing reaching a potential impasse in endeavoring to explain heat carry off — that impasse being explaining how a weak interaction can affect the tri-quark current. I was graciously assisted [20], and the following italicized material is a condensed version of this assistance which is highly cogent to my work.

The non-conservation of parity of hadronic interactions is closely related to the interaction current of neutrino couplings. Key to understanding this relationship is the unification between leptonic neutrinos and gluons. This manifests at *lower* energy values of particle couplings and is observed in decay patterns of the high-quark meson complexes, such as the top- and bottom-quarks, but these are resonant energies of the up-quark and the down-quark. The proton-neutron interconversion acts to cause a mixing of wave functions and the exchange of a mesonic mediator. This is known as Yukawa coupling, and it is the Yukawa meson that carries the antiquark which couples to an up-quark of the proton. These couplings necessarily relate to the Heisenberg zero-point energy (ZPE) metric background.

In our measurement of  $G$ , cited earlier herein, the method which we employed, involving ultra-close-length/scale gravitating bodies, interrogated by cw laser scattering (as a function of the temperature of the coupling medium of air or water), inescapably had to involve the Casimir effect and ZPE — albeit a classical or mixed version of the Casimir effect. It seems that fundamental studies of the physics of the quark-antiquark interaction must involve ZPE.

The net result is that the strong gluonic coupling can be assumed by the weak antineutrino coupling in terms of a neutral weak-interaction current. The current arises

from the triquark complex of a nucleon, and thus can re-circulate; therefore the original nucleon (such as the neutron in the  $\nu + n$  inelastic interaction) can be re-materialized. The associated long decay times are ideal for heat carry-off. The significant point to this is that the quark-antiquark coupling (designated  $ud'$ ) is transmuted into a temporary diquark selfstate (designated  $ud$ ) following a simple exchange of the state-antistate couplings of the neutral pions (designated  $dd'$  and  $uu'$ ).

My experimental results indicate that as related to gravitational interactions, the above couplings collectively are associated with time-constants, or relaxation times, of the order of a fraction of a millisecond. The results of the above analysis, and the available CERN Proton Synchrotron data on the neutrino and the antineutrino, and on the quark and the antiquark, indicate that the input-output physics of the neutrino-nucleon inelastic scattering process yields only a relatively small fraction of the input energy being converted to heat. This is because of values of masses and velocities before and after the inelastic collision do not change substantially. I estimate that the maximum heat energy would be about 15% of the input neutrino energy, and this depends upon the exit velocity of the antineutrino. Detailed quantitative calculated results giving the heat carry-off in electron volts, as a function of input energy in electron volts, will be eventually forthcoming as theoretical intra-nucleus thermodynamic codes become more detailed and comprehensive.

## 5 Conclusion and interpretation

I conclude that my conjecture/postulate that for d-quark/u-quark neutrino-inelastic- collision-induced transmutations, and consequent quark-antiquark interactions, the strong gluon energies are *not* required for neutral currents, and the weak gluon-neutrino interaction is sufficient, is supported by current accepted theory. Although the above analysis includes very complex internal nuclear processes, and although as scientists we search for elegant simplicity in explanations of nature, it seems to me that to provide an understanding of the heat carry-off phenomenon in inelastic neutrino-nucleon scattering, the invoking of these very complex workings within the nucleon is necessary.

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